

PCT/JP2003/012917  
WO 2004/045702 A1

10/527522

DT19 Rec'd PCT/PTO 10 MAR 2005

REPLACED BY  
ART 34 AMDT

REPLACEMENT SHEETS

- Amendment filed on March 26, 2004  
pursuant to Article 34 PCT -  
(English Translation)

8/Pts

10/527522

- 1 -

DT19.0004 PCT/PTO 10 MAR 2005

Our Ref: MOR-254-A

PATENT

# BALLOON CATHETER AND DEVICE FOR INFUSION THERAPY

## Technical Field

[0001] The present invention relates to a balloon catheter that can be inserted into a blood vessel to transluminally administer drugs and cells or supply a treatment instrument for treatment of cardiac muscle or the like, and a device for infusion therapy including the balloon catheter.

## Background Art

[0002] Various types of balloon catheters have been developed in quest of less invasive treatment methods for various kinds of diseases. Such a balloon catheter as a transluminal treatment device is intended to occlude main blood flow temporarily or semipermanently to examine or improve abnormality that occurs. For example, a conventional balloon catheter used in percutaneous transluminal coronary angioplasty is described in Japanese Patent Laid-Open No. 5-285222, in which an expanded balloon is mainly used to dilate a narrowed blood vessel.

[0003] For infusion of drugs, cells, or a treatment instrument such as an injection needle into cardiac muscle in which myocardial infarction occurs or may occur, infusion therapy has been considered such that the drugs or the like are directly administered by thoracotomy, or a catheter percutaneously approaches a heart chamber through inferior vena cava, a tip of the catheter is brought close to the cardiac muscle, and

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ART 34

a catheter and a device for infusion therapy suitable for the invented treatment method.

#### Disclosure of the Invention

[0009] The inventors have eagerly studied means and a method for effectively transluminally delivering drugs to a target spot without invading areas other than a diseased area using means such as a guiding catheter or the like, and found that a balloon catheter, which has a small diameter so as to be inserted into a guiding catheter and delivered to an in vivo target area, and can create an occluded area in a limited local area without occluding main blood flow, and reversely infuse drugs or the like necessary for treatment into the local area only, is suitable for achieving the object of the novel treatment method, thus reaching the invention.

[0010] In order to achieve the above described object, the invention provides a catheter and a device for infusion therapy that preserves at least main blood flow, creates an occluded area occluded from a main blood vessel between two balloons, and supplies drugs, cells, a treatment instrument, or the like according to a treatment method to the occluded area.

[0011] Specifically, the invention according to claim 1 provides a balloon catheter for insertion into a blood vessel in which a plurality of lumens extending along an axis are formed in one catheter body, and two expandable balloons expand toward outside with respect to the catheter body are arranged axially in parallel, characterized in that the plurality of lumens comprises: an infusion lumen that has an infusion hole

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ART 34 AUST

communicating with an outside of the catheter body between the two balloons; and can supply drugs, cells, a treatment instrument, or the like to the outside of the catheter body through the infusion hole; balloon lumens that communicate with insides of the two balloons to control expansion of the balloons; a bypass lumen that communicates with the outside of the catheter body in each position distal and proximal, which is outside of the two balloons with respect to a tip of the catheter body, and bypasses an occluded area formed by the two balloons to allow blood flow; and a guide lumen into which a guide wire that guides the catheter body to a target position is inserted.

[0012] According to the invention, the two balloons are expanded to form an independent occluded area in the blood vessel between the two balloons to allow the drugs or the like to be supplied through the infusion hole to the local area of the occluded area only. Thus, if a bifurcated blood vessel connects to the occluded area, the drugs or the like are infused into the bifurcated blood vessel to allow the drugs or the like to be supplied to a diseased area through the bifurcated blood vessel. Of course, if there is a diseased area in a blood vessel wall that constitutes the occluded area, drugs or the like only necessary for the local diseased area can be supplied.

[0013] It is also possible to cause a negative pressure in the infusion lumen to suck and remove, from the infusion hole, substances in the occluded area such as the drugs supplied through the infusion hole.

[0014] Blood flow is ensured by the bypass lumen even if the blood vessel is occluded by the balloons, and thus blood flow in the blood vessel can be ensured even if the blood vessel is occluded by the balloons for a predetermined time for conservative therapy or the like.

[0015] Next, the invention according to claim 2 is characterized in that one balloon lumen communicates with the insides of the two balloons in addition to the configuration according to claim 1.

[0016] According to the invention, only one lumen is required for expanding the two balloons, thus reducing the number of lumens in the catheter body to increase a sectional area of a hole of the bypass lumen.

[0017] Next, the invention according to claim 3 is characterized in that the guide lumen opens into the outside of the catheter body in each position distal and proximal, which is outside of the two balloons to also serve as the bypass lumen in addition to the configuration according to claim 1 or 2.

[0018] According to the invention, there is no need for the independent bypass lumen, thus reducing the number of lumens in the catheter body to increase the sectional area of the hole of the bypass lumen.

[0019] Next, the invention according to claim 4 is characterized in that the balloon catheter is a catheter for insertion into a coronary vein in addition to the configuration according to any one of claims 1 to 3.

[0020] According to the invention, an unknown approach to an organ is allowed such that various factors, drugs, and cells

are infused into a diseased area such as an ischemia area in reverse of blood flow through the coronary vein to substantially treat the organ.

[0021] Specifically, master cells or drugs can be administered to target cardiac muscle tissue only through the bifurcated blood vessel connecting to the occluded area formed by the two balloons. In this case, there is no need to directly insert the catheter up to the target cardiac muscle tissue.

[0022] Next, the invention according to claim 5 provides a device for infusion therapy characterized by including: a balloon catheter according to claim 4; a guide wire to be inserted into a guide lumen; pulsation detection means for detecting pulsation of the heart; and stroke means for causing the guide wire to stroke in synchronization with the pulsation of the heart based on a detection signal of the pulsation detection means.

[0023] According to the invention, pumping action in the bypass lumen by causing the guide wire to stroke in synchronization with the pulsation of the heart improves efficiency of blood circulation by the bypass lumen.

[0024] If lost cells of cardiac muscle tissue or a blood vessel can be reconstituted by infusing various factors, drugs, cells or the like, the condition of the disease can be essentially improved. The treatment method to which the invention is suitably applied, that is, the idea of the approach to an organ such that various factors, drugs, and cells are infused into an ischemia area in reverse of blood flow through the coronary vein to substantially treat the organ has been unknown.

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ART 34 AUST

#### Brief Description of the Drawings

[0025] Figure 1 is a side schematic view of a catheter according to an embodiment of the invention;

[0026] Figure 2 is a sectional diagram of the catheter in use according to the embodiment of the invention;

[0027] Figure 3 is a sectional view taken along the line A-A in Figure 1;

[0028] Figure 4 is a sectional view taken along the line B-B in Figure 1;

[0029] Figure 5 is a sectional view taken along the line D-D in Figure 1;

[0030] Figure 6 is a sectional view taken along the line C-C in Figure 1;

[0031] Figure 7 is a sectional view taken along the line E-E in Figure 1;

[0032] Figure 8 illustrates use of the catheter according to the embodiment of the invention; and

[0033] Figure 9 is a schematic block diagram of an operation of a guide wire according to the embodiment of the invention.

#### Best Mode for Carrying out the Invention

[0034] Now, an embodiment of the invention will be described with reference to the drawings.

[0035] Figure 1 is a side schematic view of a balloon catheter according to an embodiment of the invention, and two balloons 2 and 3 are provided at a predetermined spaced interval on

Claims

1. A balloon catheter for insertion into a blood vessel in which a plurality of lumens extending along an axis are formed in one catheter body, and two expandable balloons expand toward outside with respect to the catheter body are arranged axially in parallel,

characterized in that said plurality of lumens comprises:

an infusion lumen that has an infusion hole communicating with an outside of the catheter body between said two balloons, and can supply drugs, cells, a treatment instrument, or the like to the outside of the catheter body through said infusion hole;

balloon lumens that communicate with insides of said two balloons to control expansion of said balloons;

a bypass lumen that communicates with the outside of the catheter body in each position distal and proximal, which is outside of said two balloons with respect to a tip of the catheter body, and bypasses an occluded area formed by the two balloons to allow blood flow; and

a guide lumen into which a guide wire that guides the catheter body to a target position is inserted.

2. A balloon catheter according to claim 1, characterized in that one balloon lumen communicates with the insides of said two balloons.

3. A balloon catheter according to claim 1 or 2, characterized in that said guide lumen communicates with the outside of the



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ART 34 ADOT

catheter body in each position distal and proximal, which is outside of said two balloons to also serve as said bypass lumen.

4. A balloon catheter according to any one of claims 1 to 3, characterized in that said balloon catheter is a catheter for insertion into a coronary vein.

5. A device for infusion therapy characterized by comprising:  
a balloon catheter according to claim 4;  
a guide wire to be inserted into a guide lumen;  
pulsation detection means for detecting pulsation of the heart; and

stroke means for causing said guide wire to stroke in synchronization with the pulsation of the heart based on a detection signal of the pulsation detection means.